

What is claimed:

1                   1.       A dielectric layer (12) disposed on the surface (14) of a substrate  
2 (16), the dielectric layer having a top surface (18), wherein the dielectric layer  
3 comprises a first dielectric gradient region (26, 44) in which a dielectric constant  $k$   
4 decreases continuously from a maximum value to a minimum value with distance from  
5 the substrate surface.

1                   2.       The dielectric layer (12) according to claim 1 wherein an  
2 instantaneous rate of decrease of  $k$  in the first dielectric gradient region (26) is between  
3 0.025 and 0.5 per 10 nm of the dielectric thickness (13) at substantially every location  
4 throughout the first dielectric gradient region (26).

1                   3.       The dielectric layer (12) according to claim 1 wherein an  
2 instantaneous rate of decrease of  $k$  in the first dielectric gradient region (26) is between  
3 0.05 and 0.1 per 10 nm of the dielectric thickness (13) at substantially every location  
4 throughout the first dielectric gradient region (26).

1                   4.       The dielectric layer (12) according to claim 1 wherein the  
2 minimum value of  $k$  in the first dielectric gradient region (26) represents a reduction of  
3 at least 0.2 relative to the maximum value.

1                   5.       The dielectric layer (12) according to claim 1 wherein the  
2 minimum value of  $k$  in the first dielectric gradient region (26) represents a reduction of  
3 at least 0.5 relative to the maximum value.

1                   6.       The dielectric layer (12) according to claim 1 wherein the  
2 instantaneous rate of decrease of  $k$  in the first dielectric gradient region (26) varies  
3 linearly with distance from the substrate surface (14).

1                   7.       The dielectric layer (12) according to claim 1 wherein the  
2 instantaneous rate of decrease of  $k$  in the first dielectric gradient region (26) varies  
3 nonlinearly with distance from the substrate surface (14).

1                   8.       The dielectric layer (12) according to claim 1 wherein the first  
2 dielectric gradient region (26) is adjacent the substrate surface (14).

1                   9.       The dielectric layer (12) according to claim 1 wherein the first  
2 dielectric gradient region (26) is not adjacent the substrate surface (14), the dielectric  
3 layer (12) further comprising an initial dielectric region (24) bounded by the substrate  
4 surface (14) and the first dielectric gradient region (26).

1           10.    The dielectric layer (12) according to claim 1 wherein the first  
2 dielectric gradient region (26) consists essentially of chemical vapor deposition  
3 products.

1           11.    The dielectric layer (12) according to claim 1 wherein the  
2 dielectric layer consists essentially of chemical vapor deposition products.

1           12.    The dielectric layer (12) according to claim 1 wherein the  
2 dielectric layer further comprises a second dielectric gradient region (30, 38, 46) in  
3 which  $k$  increases continuously with distance from the substrate surface (14).

1           13.    The dielectric layer (12) according to claim 12 wherein the second  
2 dielectric gradient region (30, 38, 46) forms the top surface (18) of the dielectric layer  
3 (12).

1           14.    The dielectric layer (12) according to claim 12 wherein the  
2 dielectric layer further comprises a third dielectric gradient region (34) in which  $k$   
3 decreases continuously with distance from the substrate surface (14), the third  
4 dielectric gradient region being farther than the second dielectric gradient region (30)  
5 from the substrate surface.

1           15.    The dielectric layer (12) according to claim 14 wherein the third  
2 dielectric gradient region (34) is adjacent the second dielectric gradient region (30).

1           16.    The dielectric layer (12) according to claim 14 wherein the third  
2 dielectric gradient region (34) is not adjacent the second dielectric gradient region  
3 (30), the dielectric layer further comprising an intermediate dielectric region (32)  
4 bounded by the second dielectric gradient region (30) and the third dielectric gradient  
5 region (34).

1           16.    A semiconductor device comprising a dielectric layer (12)  
2 according to claim 1.

1           17.    A process of making a dielectric layer (12) disposed on the surface  
2 (14) of a substrate (16), the process comprising applying directly or indirectly to the  
3 substrate, under chemical vapor deposition conditions, a continuously varying  
4 composition of chemical vapor deposition precursors to form a first dielectric gradient  
5 region (26) in which a dielectric constant  $k$  decreases continuously from a maximum  
6 value to a minimum value with distance from the substrate surface.

1           18.    The process of claim 17 further comprising applying to the  
2 substrate an initial dielectric region (24) and then applying the first dielectric gradient  
3 region (26) to the substrate.

1                   19.     A process of making a semiconductor device that comprises a  
2 dielectric layer (12) disposed on a surface (14) of a substrate (16), the process  
3 comprising applying directly or indirectly to the substrate, under chemical vapor  
4 deposition conditions, a continuously varying composition of chemical vapor deposition  
5 precursors to form a first dielectric gradient region (26) in which a dielectric constant  $k$   
6 decreases continuously from a maximum value to a minimum value with distance from  
7 the substrate surface.

1                   20.     The process of claim 19 further comprising applying to the  
2 substrate an initial dielectric region (24) and then applying the first dielectric gradient  
3 region (26) to the substrate.